Center Independent Research & Development: GSFC IRAD

X-band Cube Satellite Communication System Demonstration

Completed Technology Project (2014 - 2015)

Project Introduction

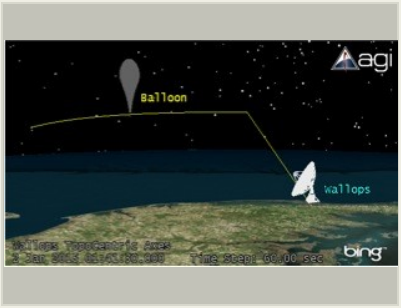
This work will develop, test and demonstrate an end-to-end innovative, compact, efficient and low cost S-band uplink and X-band downlink CubeSat Communication System between a balloon and/or sounding rocket and a NEN ground system (Wallops Ground System (WGS) 11.28 meter system) to support current and future CubeSat communication needs. 3D EM simulations and STK with real and simulated gain patterns will be used to design this communication system. The outcome of this study will be used to pave the way of next generation NEN compatible X-band CubeSat communication system to support higher data rates with more advanced modulation and forward error correction (FEC) coding schemes and to support and attract new science missions at lower cost.

This research has three main objectives.

- Design, simulate and test a CubeSat S- and X-band communication system. STK and HFSS Simulations and modeling results will be used to trade the merit of various designs for small satellite applications. S- and X-band antennas will be tested in the compact antenna test range to gather radiation pattern data.
- Simulate and Test a CubeSat compatible X-band communication system including S-band antennas, X-band antennas and LASP/GSFC transmitter S-band receiver from TRL-5 to TRL-8 by the end of this effort.
    - Different X-band communication systems with components, at GSFC, other NASA centers, universities, private companies, such as antennas and diplexers etc. will be investigated and traded.
    - We will identify a complete component list for the communication system baseline by performing some analytical and numerical analysis work. This objective includes running simulations and doing trades between different X-band antenna systems and optimizing communication system performance.
- Final objective is to test an end-to-end X-band CubeSat communication system demo between a balloon and/or sounding rocket and a NEN system, WGS 11.28 meter system or equivalent, and look for a possible CubeSat mission. The proposed work will be completed in one year and then possible future "NASA's Science Mission Directorate CubeSat Initiative" demonstration candidates will be explored.

Anticipated Benefits

This X-band communication system will be NEN compatible and it will be used as a potential standard baseline for CubeSats throughout NASA, other



X-band Cube Satellite Communication System Demonstration Project (XCSCSD)

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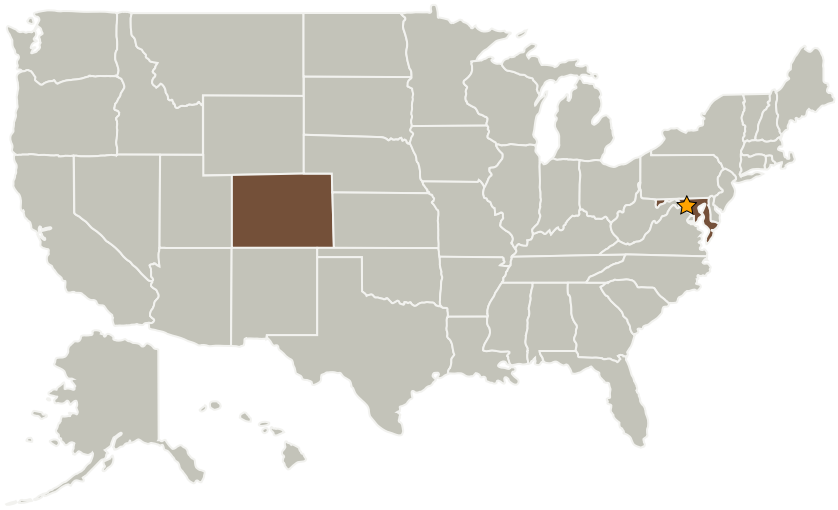
government agencies and universities. This work will increase NASA CubeSat/SmallSat development capabilities. These capabilities will attract new science missions to consider the low cost option of using CubeSat/SmallSat platforms. Also, the proposed X-band communication system will be a test bed for new technology demonstration missions that will enable new mission classes or reduce the cost, schedules and risk of current NASA mission design methodologies.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
University of Colorado Boulder	Academia	Boulder, Colorado

Primary U.S. Work Locations	
Colorado	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Wesley A Powell

Principal Investigator:

Serhat Altunc

Co-Investigators:

Obadiah O Kegege
Darren O'connor
Scott E Palo

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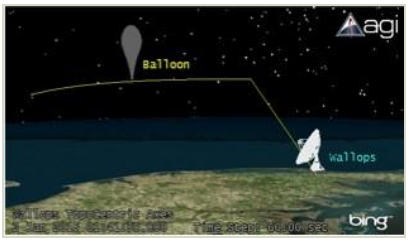
Images



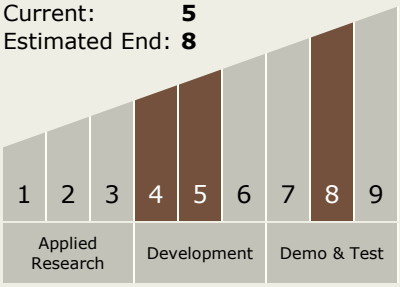
X-band Cube Satellite Communication System Demonstration Project (XCSCSD)
X-band Cube Satellite Communication System Demonstration Project (XCSCSD)
(https://techport.nasa.gov/image/17691)

Project Website:

http://aetd.gsfc.nasa.gov/

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **8**



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.1 Optical Communications
    - TX05.1.7 Innovative Signal Modulations